--47. (New) A method according to any one of Claims 18, 30, and 31, wherein the heating is conducted at a temperature of not higher than 150°C.--

REMARKS

Claims 1-5, 7-34, 37-38 and 40-47 are now presented for examination. Claims amend Claims 1, 2, 7, 8, 11, 14-25, 27, 29-34, 36-38, 40-42, 44 and 46 have been amended as shown above. Claims 6, 35, and 39 have been canceled. Claim 47 has been added to provide Applicants with a more complete scope of protection.

Claims 1, 2, 14-18, 30, and 31 are the only independent claims.

In the Office Action, Claims 1-8, 11-24, 27-41, and 44-46 were rejected under 35 U.S.C. 103(a) as being unpatentable over either U.S. Patent 6,034,478 (Kawade et al.) or Japanese Laid-Open Patent Application No. Hei 09-298029 (JP09-298029) in view of Japanese Patent Laid-Open No. 64-19658 (Banno et al.), Claims 9-12, 25, 26, 42, and 43 were rejected under Section 103(a) as being unpatentable over either Kawade et al. or JP09-298029 in view of Banno et al., and further in view of European Patent Application 0 769 796 A1 (Taiko et al.). Claims 1-8, 11-24, 27-41, and 44-46 also were rejected under Section 103(a) as being unpatentable over either Kawade et al. or JP09-298029 in view of Banno et al., and further in view of Japanese Patent Laid-Open No. 6-12997 (Ueno et al.). Applicants offer the following comments with regard to these rejections.

Initially, cancellation of Claims 6, 35, and 39 renders their rejection moot.

In accordance with an aspect of the present invention, methods are provided for producing an electron-emitting device, an electron source comprising a plurality of the

electron-emitting devices, and an image forming apparatus. The methods comprise, *inter alia*, a step of heating a substrate on which an electroconductive film is disposed, and a step of energizing the electroconductive film, and those steps preferably are conducted within an atmosphere comprising a gas for promoting cohesion of the electroconductive film.

In accordance with one embodiment of the invention, which, for convenience, is hereinafter referred to as "embodiment A", the substrate on which the electroconductive film is disposed is heated within the atmosphere comprising a gas for promoting cohesion of the electroconductive film, at a temperature of not higher than 150°C (see, e.g., amended Claims 1, 2, 14, 15, 16, and 17). Support for the feature of conducting heating at that temperature is found in the originally filed specification, at least in Table 1 on page 67. Embodiment A solves a problem described at page 21, lines 3-10 of the specification, experienced in cases where the temperature at which the substrate (on which the electroconductive film is disposed) is heated within such an atmosphere is too high.

In accordance with another embodiment of the invention, which, for convenience, is hereinafter referred to as "embodiment B", the atmosphere comprising a gas for promoting cohesion of the electroconductive film is formed after the start of the heating of the substrate on which the electroconductive film is disposed and the start of the energizing of the electroconductive film (see, e.g., Claims 18, 30, and 31). Embodiment B provides advantages that may be understood in view of the following comments. As the temperature at which a substrate on which an electroconductive film is disposed is increased, the time taken for cohesion to occur ~~increases~~ decreases substantially. For example, in one

Corrected per ~~See~~ e.g. last paragraph paper #25 page 4 ~~for~~ KJK

case, hereinafter referred to as "case (1)", the electroconductive film is not subjected to energizing, and is disposed under a condition where the temperature is about 100°C (see, e.g., Ex.1 in Table 1 on page 67). As another example, hereinafter referred to as "case (2)", the electroconductive film again is not energized, and is disposed under a condition where the temperature is about 25°C (see, e.g., Ref. Ex.1 in Table 1 on page 67). Whereas in case (1) it takes only about a few seconds for the cohesion to progress sufficiently for enabling the electroconductive film material to become reduced and the resistance thereof lowered, in case (2) about an hour elapsed before the resistance lowered.

Accordingly, before heating and energizing the electroconductive film, when the electroconductive film is disposed within the atmosphere promoting the cohesion of the electroconductive film, even if the period beginning from after the forming of the atmosphere promoting the cohesion until a start of the energizing and heating is very short (e.g., a few seconds), the manner in which the cohesion progresses may be undesirable. Accordingly, even a slight variation in a start timing of the energizing can cause an undesirably greater variation in the progression of the cohesion at the start of the energizing. As a result, it can become difficult to reproducibly complete an electron-emitting region at the electroconductive film, and process control can also become difficult. Embodiment B prevents such problems since the atmosphere comprising a gas for promoting cohesion of the electroconductive film preferably is formed after the start of the heating of the substrate (on which the electroconductive film is disposed) and the start of the energizing of the electroconductive film.

Independent Claims 1, 2, and 18 will now be discussed.

As amended, independent Claim 1 is directed to a method for producing an electron-emitting device including a pair of electrodes and an electroconductive film having an electron-emitting region. The electroconductive film is disposed between the pair of electrodes, and the electron-emitting region is formed by a process comprising the steps of heating, at a temperature not higher than 150°C, a substrate on which an electroconductive film is disposed, and energizing the electroconductive film. The steps of heating and energizing are conducted within an atmosphere comprising a gas for promoting cohesion of the electroconductive film.

As amended, independent Claim 2 is directed to a method for producing an electron-emitting device including a pair of electrodes and an electroconductive film having an electron-emitting region. The electroconductive film is disposed between the pair of electrodes. The electron-emitting region is formed by a process including the steps of preparing an electroconductive film, and energizing the electroconductive film, while heating a substrate on which the electroconductive film is disposed at a temperature not higher than 150°C within an atmosphere comprising a gas for promoting cohesion of the electroconductive film.

Also as amended, independent Claim 18 is directed to a method for producing an electron-emitting device including a pair of electrodes and an electroconductive film having an electron-emitting region. The electroconductive film is disposed between the pair of electrodes, and the electron-emitting region is formed by a process of preparing an the electroconductive film, and energizing the electroconductive

film while heating a substrate on which the electroconductive film is disposed within a predetermined atmosphere comprising a gas for promoting cohesion of the electroconductive film. After the start of the energizing and the heating, the predetermined atmosphere including the gas for promoting the cohesion of the electroconductive film is formed.

Kawade et al. and JP09-298029 refer to an electroconductive film that is subjected to energization within an atmosphere for promoting cohesion of the electroconductive film. As a pulse voltage is applied between device electrodes to cause electric current to flow through the electroconductive film, heat is thermally generated in the film itself as a result of that energization of the film. The Office Action cites those references as teaching energization forming an electroconductive film in an atmosphere comprising a gas that produces cohesion of the film while heating the film by resistance.

Banno et al. refers to an electroconductive film being heated by a heater 25 while the electroconductive film is being energized (see, e.g., Fig. 2). The complete electroconductive film is heated by the heater 25 to prevent a breakage in a substrate caused by localized heating during the energizing of the electroconductive film (see, e.g., page 3, last line through page 4, line 1, and page 4, lines 13-18 in the English translation of Banno et al., of record).

Ueno et al. relates to a surface-conduction type of electron emitting device in which a position and shape of an electron emission portion are controlled, and is cited in the Office Action as teaching the use of a flowing reducing atmosphere of H_2 gas of SCCM in a vacuum, to reduce energization time from one minute to 100 msec.

Applicants respectfully submit that, while Kawade et al., JP09-298029, Banno et al., and Ueno et al. may be well-suited for their intended purposes, nothing in those references would teach or suggest forming an electron-emitting region by a process comprising the steps of heating, at a temperature not higher than 150°C, a substrate on which an electroconductive film is disposed, and energizing the electroconductive film, wherein the heating and energizing steps are conducted within an atmosphere comprising a gas for promoting cohesion of the electroconductive film, as recited in Claim 1, or forming an electron-emitting region by a process including energizing an electroconductive film while heating a substrate on which the electroconductive film is disposed at a temperature not higher than 150°C within an atmosphere comprising a gas for promoting cohesion of the electroconductive film, as recited in Claim 2. Applicants also respectfully submit that those references also do not teach or suggest forming an electron-emitting region by energizing an electroconductive film while heating a substrate on which the electroconductive film is disposed within a predetermined atmosphere comprising a gas for promoting cohesion of the electroconductive film, wherein after the start of the energizing and the heating, the predetermined atmosphere including the gas for promoting the cohesion of the electroconductive film is formed, as recited in Claim 18.

Moreover, although the Office Action asserts that (i) "[t]he determination of the optimum amount of preheating required to avoid cracking of the substrate would have involve routine shop practice", (ii) "since Kawade et al discloses the use of a volatile carrier for the electroconductive film which is baked out, it would have been obvious to delay the introduction of the reducing atmosphere until after initial processing has remove the volatile

constituents", and (iii) [s]ince used of a flowing reducing gas prior to energization would be a waste of gas, it would have been obvious . . . to delay the application of the H_2 until the electroconductive film was heated by energization in order to make the most practicable use of the gas", Applicants submit that the references relied on by the Examiner to reject Claims 1, 2, and 18 are not concerned with a need to solve the above-described problems which can occur when a substrate on which an electroconductive film is disposed is heated and the electroconductive film is energized within an atmosphere comprising a gas for promoting cohesion of the electroconductive film. Accordingly, there would have been no reason why one skilled in the art, who was faced with the same problems confronted by Applicants at the time of their invention, would have even consulted the references relied on by the Examiner, let alone been motivated to combine them as proposed in the Office Action. For this reason, it is respectfully submitted that the Office Action has failed to establish a *prima facie* case of obviousness against Claims 1, 2, and 18 of the present application.

For all of the foregoing reasons, Applicants respectfully submit that Claims 1, 2, and 18 are clearly patentable over Kawade et al., JP09-298029, and Banno et al., and over Kawade et al., JP09-298029, Banno et al., and Ueno et al., whether those references are considered separately or respective combinations.

Independent Claims 14 and 15 are directed to a method for producing an electron source and a method for producing an image-forming apparatus, respectively, and each recite features that are similar in many relevant respects to those of Claim 1 discussed above relating to the heating of a substrate at a temperature of not higher than 150°C, and

and also are believed to be clearly patentable over those references for the same reasons as is Claim 1.

Independent Claims 16 and 17 are directed to a method for producing an electron source and a method for producing an image-forming apparatus, respectively, and each recites features that are similar in many relevant respects to those of Claim 2 discussed above relating to the heating of a substrate at a temperature of not higher than 150°C, and also are believed to be clearly patentable over the references relied on by the Examiner for the same reasons as is Claim 2.

Independent Claims 30 and 31 are directed to a method for producing an electron source and a method for producing an image-forming apparatus, respectively, and each recite features that are similar in many relevant respects to those of Claim 18 discussed above relating to the forming of a predetermined atmosphere including a gas for promoting the cohesion of an electroconductive film, after the start of energizing and heating, and also are believed to be clearly patentable over the references relied on by the Examiner for the same reasons as is Claim 18.

A review of the other art of record has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of

the invention, however, the individual consideration or reconsideration, as the case may be, of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

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VERSION WITH MARKINGS SHOWING CHANGES MADE TO CLAIMS

1. (Amended) A method for producing an electron-emitting device including a [plurality] pair of electrodes and an electroconductive film having an electron-emitting region, said electroconductive film [extending between the plurality] being disposed between the pair of electrodes, wherein [the] said electron-emitting region is formed by a process comprising the steps of:

heating, [the] at a temperature not higher than 150°C, a substrate on which an electroconductive film is disposed; and

energizing the electroconductive film [in],

wherein the steps of heating and energizing are conducted within an atmosphere comprising a gas for promoting cohesion of the electroconductive film.

2. (Amended) A method for producing an electron-emitting device including a [plurality] pair of electrodes and an electroconductive film having an electron-emitting region, said electroconductive film [extending between the plurality] being disposed between the pair of electrodes, wherein [the] said electron-emitting region is formed by a process including the steps of:

preparing [providing] an electroconductive film; and

energizing [the] said electroconductive film, while heating [the] a substrate on which said electroconductive film is disposed at a temperature not higher than 150°C

within an atmosphere comprising a gas for promoting cohesion of the electroconductive film.

6. (Canceled)

7. (Amended) The method according to Claim [6] 1 or 2, wherein the heating of the substrate is carried out at a temperature not [more] higher than 100 °C.

8. (Amended) The method according to Claim [6] 1 or 2, wherein the heating of [said] the substrate is carried out at a temperature in the range of 50 °C to 100°C.

11. (Amended) The method according to Claim 1 or 2, wherein [said] a material to be subjected to the heating and the energizing so as to be formulated into said electroconductive film [is an electroconductive film comprising] comprises a metallic oxide [as a matrix].

14. (Twice Amended) A method for producing an electron source [having] comprising a plurality of electron-emitting devices, each including a pair of electrodes and an electroconductive film having an electron-emitting region, said electroconductive film being disposed between the pair of electrodes, comprising the steps of:

forming [a] said plurality of electron-emitting devices by a [method] process including the steps of:

heating, at a temperature not higher than 150°C, a substrate on which a plurality of [an] electroconductive films are disposed; and

energizing said electroconductive films,

wherein said steps of heating and energizing are conducted within [the electroconductive film in] an atmosphere comprising a gas for promoting cohesion of the electroconductive film.

15. (Twice Amended) A method for producing an image-forming apparatus comprising (a) an electron source [having] comprising a plurality of electron-emitting device, each including a pair of electrodes and an electroconductive film having an electron-emitting region, said electroconductive film being disposed between the pair of electrodes, and (b) an image-forming member for forming an image under irradiation of electrons emitted from the electron source, the method comprising the steps of:

forming [a] said plurality of electron-emitting devices by a [method] process including the steps of[;]:

heating, at a temperature of not higher than 150°C, a substrate on which a plurality [an] of electroconductive films are disposed; and

energizing [the] said electroconductive films,

wherein the steps of heating and energizing are conducted within [in] an atmosphere comprising a gas for promoting cohesion of the electroconductive films.

16. (Twice Amended) A method for producing an electron source [having] comprising a plurality of electron-emitting devices, each including a pair of electrodes and an electroconductive film having an electron-emitting region, said electroconductive film being disposed between the pair of electrodes, comprising the steps of:

forming [a] said plurality of electron-emitting devices by a [method comprising] process including the steps of:

preparing a plurality of [providing an] electroconductive films; and

energizing [the] said electroconductive films, while heating [the film, in] a substrate on which said electroconductive films are disposed at a temperature of not higher than 150°C within an atmosphere comprising a gas for promoting cohesion of the electroconductive film.

17. (Twice Amended) A method for producing an image-forming apparatus comprising (a) an electron source [having] comprising a plurality of electron-emitting devices, each including a pair of electrodes and an electroconductive film having an electron-emitting region, said electroconductive film being disposed between the pair of electrodes, and (b) an image-forming member for forming an image under irradiation of electrons emitted from the electron source, the method comprising the steps of:

forming [a] said plurality of electron-emitting devices by a [method] process including the steps of:

preparing a plurality of [providing an] electroconductive films; and

energizing [the] said electroconductive films, while heating [the film, in] a substrate on which said electroconductive films are disposed at a temperature of not higher than 150°C within an atmosphere comprising a gas for promoting cohesion of the electroconductive film.

18. (Amended) A method for producing an electron-emitting device including a [plurality] pair of electrodes and an electroconductive film having an electron-emitting region, said electroconductive film being disposed [extending] between the [plurality] pair of electrodes, wherein [the] said electron-emitting region is formed by [the steps] a process of:

preparing an [providing] the electroconductive film; and

energizing [the] said electroconductive film while heating [the] a substrate on which said electroconductive film [in an] is disposed within a predetermined atmosphere comprising a gas for promoting cohesion of the electroconductive film, wherein, after the start of the energizing and the heating, the predetermined atmosphere including the gas for promoting the cohesion of the electroconductive film is [provided] formed.

19. (Amended) The [A] method [for producing an electron-emitting device that includes a substrate, a plurality of electrodes, and an electroconductive film having an electron-emitting region, wherein the electroconductive film is disposed on the substrate and at least a portion of the electroconductive film extends between the plurality of electrodes, and wherein the electron-emitting region is formed by the steps of:

heating to a predetermined temperature the substrate on which the electroconductive film is disposed;

energizing the electroconductive film, wherein the energizing starts after the predetermined temperature is reached; and

controlling an atmosphere in which the heating and energizing steps are performed so that the atmosphere is set to one comprising a gas for promoting cohesion of the electroconductive film during the performance of the heating and energizing steps] according to Claim 18, wherein, after the start of the heating, the energizing starts.

20. (Amended) The method according to any one of Claims 14 [or 16] to 19, wherein the gas for promoting the cohesion of the electroconductive film is a reducing gas.

21. (Amended) The method according to any one of Claims 14 [or 16] to 19, wherein the gas for promoting the cohesion of the electroconductive film is H_2, CO, or CH_4.

22. (Amended) The method according to any one of Claims 14 [or 16] to 19, wherein the gas for promoting the cohesion of the electroconductive film is H_2.

23. (Amended) The method according to any one of Claims 14 [or 16] to 17, wherein the heating of the substrate is carried out at a temperature of not more than approximately 100°C.

24. (Amended) The method according to any one of Claims 14 [or 16] to 17, wherein the heating of the substrate is carried out at a temperature in the range of 50°C to 100°C.

25. (Amended) The method according to any one of Claims 14 [or 16] to 19, further comprising the step of forming the electroconductive film by dispensing a droplet containing a metallic compound onto the substrate.

27. (Amended) The method according to any one of Claims 14 [or 16] to 19, wherein [the] a material to be subjected to the heating and the energizing so as to be formulated into said electroconductive film comprises a metallic oxide [having a matrix configuration].

29. (Amended) The method according to any one of Claims 14 [or 16] to 19, wherein the electron-emitting device is a surface conduction electron-emitting device.

30. (Amended) A method for producing an electron source comprising a plurality of electron-emitting devices, each including a pair of electrodes and an electroconductive film having an electron-emitting region, said electroconductive film being disposed between the pair of electrodes, comprising the steps of:

forming [a] said plurality of electron-emitting devices by a [method] process including the steps of:

[forming an] preparing a plurality of electroconductive films [on a substrate]; and

[heating the substrate on which the electroconductive film is formed;

energizing the electroconductive film; and

controlling an atmosphere so that a gas included in the atmosphere maintains a cohesion of the electroconductive film during at least part of the heating and energizing steps, wherein after the start of the energizing and heating steps, the atmosphere including the gas is provided, and wherein the gas promotes cohesion of the electroconductive film]

energizing said electroconductive films, while heating a substrate on which said electroconductive films are disposed within a predetermined atmosphere comprising a gas for promoting cohesion of the electroconductive films, wherein after the

start of the energizing and the heating, the predetermined atmosphere including the gas for promoting the cohesion of the electroconductive films is formed.

31. (Amended) A method for producing an image-forming apparatus comprising (a) an electron source [having] comprising a plurality of electron-emitting devices, each including a pair of electrodes and an electroconductive film having an electron-emitting region, said electroconductive film being disposed between the pair of electrodes, and (b) an image-forming member for forming an image under irradiation of electrons emitted from the electron source, the method comprising the steps of:

forming [a] said plurality of electron-emitting devices by a [method] process including the steps of:

[forming an] preparing a plurality of electroconductive films [on a substrate]; and

[heating the substrate on which the electroconductive film is formed;

energizing the electroconductive film; and

controlling an atmosphere so that a gas included in the atmosphere maintains cohesion of the electroconductive film during at least part of the heating and energizing steps, wherein after the start of the energizing and heating steps, the atmosphere including the gas is provided, and wherein the gas promotes cohesion of the electroconductive film]

energizing said electroconductive films, while heating a substrate on which said electroconductive films are disposed within a predetermined atmosphere comprising a gas for promoting cohesion of the electroconductive films, wherein, after the start of the energizing and the heating, the predetermined atmosphere including the gas for promoting the cohesion of the electroconductive films is stored.

32. (Amended) [A] The method [for producing an electron source, comprising the steps of:

forming a plurality of electron-emitting devices by a method including the steps of:

forming an electroconductive film on a substrate;

heating to a predetermined temperature the substrate on which the electroconductive film is disposed;

energizing the electroconductive film, wherein the energizing step starts after the predetermined temperature is reached; and

controlling an atmosphere in which the heating and energizing steps are performed so that the atmosphere is set to one comprising a gas for promoting cohesion of the electroconductive film during the performance of the heating and energizing steps] according to Claim 30, wherein after the start of heating, the energizing starts.

33. (Amended) [A] The method [for producing an image-forming apparatus comprising (a) an electron source having a plurality of electron-emitting devices and (b) an image-forming member for forming an image under irradiation of electrons from the electron source, the method comprising the steps of:

forming a plurality of electron-emitting devices by a method including the steps of:

forming an electroconductive film on a substrate;

heating to a predetermined temperature the substrate on which the electroconductive film is disposed;

energizing the electroconductive film,

wherein the energizing starts after the predetermined temperature is reached;

controlling an atmosphere in which the heating and energizing steps are performed so that the atmosphere is set to one comprising a gas for promoting cohesion of the electroconductive film during the performance of the heating and energizing steps] according to Claim 31, wherein after the start of the heating, the energizing starts.

34. (Amended) The method according to any one of Claims [6] 18, 19, and 30-33, wherein the heating of said substrate is conducted at a temperature of not higher than 150°C.

35. (Canceled)

36. (Amended) The method according to any one of Claims [15-17] 30-33, wherein the gas for promoting the cohesion of the electroconductive film is a reducing gas.

37. (Amended) The method according to any one of Claims [15-17] 30-33, wherein the gas for promoting cohesion of the electroconductive film is H_2, CO or CH_4.

38. (Amended) The method according to any one of Claims [15-17] 30-33, wherein the gas for promoting the cohesion of the electroconductive film is H_2.

39. (Canceled)

40. (Amended) The method according to any one of Claims [39] 18, 19 and 30-33, wherein the heating of the substrate is carried out at a temperature not more than 100 °C.

41. (Amended) The method according to any one of Claims [39] 18, 19 and 30-33, wherein the heating of said substrate is carried out at a temperature in the range of 50 °C to 100°C.

42. (Amended) The method according to any one of Claims [15-17] 30- 33, wherein said electroconductive film is an electroconductive film formed through a step of dispensing a droplet containing a metallic compound onto a substrate.

44. (Amended) The method according to any one of Claims [15-17] 30-33, wherein said electroconductive film is an electroconductive film comprising a metallic oxide as a matrix.

46. (Amended) The method according to any one of Claims [15-17] 30-33, wherein said electron-emitting device is a surface conduction electron-emitting device.

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